Optics and spectroscopy of atmosphere gases atoms and molecules: nonlinear spectroscopic effects

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In process of the IR laser radiation (LR) resonance absorption in atmosphere it occurs the redestribution of molecules on energy levels of internal freedom degrees.Creation of the excited nitrogen molecules due the resonance excitation transmission from carbon dioxide molecules leads to the medium polarizability changing. As result it could be substantionally changed the IR LR propogation conditions. Here we consider the role of resonance spectroscopic effects in the forming of the nonlinear atmosphere gases behaviour for propogation of the powerful LR pulses under different conditions and atmosphere models. As a basic model for the absorbed energy relaxation description it's used 3-mode kinetic processes model. It's numerically shown the change in the time dependence of the resonance radiation absorption coefficient for carbon dioxide under different conditions. Stimulated light scattering in atmospheric gases are also considered. On the basis of the operator perturbation theory form and QED moments technique [1] it's developed the effective approach for description of the LR atmosphere multiphoton absorption and Stark dynamic shift (these effects can be used as the physical basis for new distance methods of environment laser diagnostics). We have calculated shift and width for 3-photon resonance, 4-photon ionization profile of atomic hydrogen (transition 1s-2p; wavelength 365nm; multimode Gauss pulse: band width 0.25 cm^{-1}). It's received a good agreement with the experiment data of Kelleher et al. and Zoller stochastic calculation. We also examined effect of 2-photon LR adsorption on vibration-rotational molecular transitions [4]: CO2 LR (intensity: 10^7 W/cm^2) in the water steam 010 band and received for 2-photon adsorption probability $\sim$ (2-3)10^9 s^{-1},that is in agreement with result of Letokhov and coworkers [2]: (1-1,5)10^9 s−1. It is on several orders less than value of one-photon process probability.

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